

Peatland conservation – from cinders to Cinderella

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Peatlands are rare and extraordinary habitats which hover on the borderline between the aquatic and the terrestrial, but the steady loss of Britain's peatlands has gone unremarked until recently. In lowland England some 37 000 ha have been reduced to less than 500 ha of natural bog and losses on such a scale are found throughout Europe.

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Introduction

The peat bogs of Britain represent some of the very last remnants of this country's truly primaevial landscape and are a habitat which is a significant international responsibility. Yet if peat bogs are thought of at all, it is likely to be with a sense of indifference or hostility. Their fringes are littered with the debris of society, they are drained, covered with trees, dug up to put into plant pots, burned, accidentally or deliberately, to leave a wasteland of ash and cinders. In contrast to the value, even veneration, accorded to ancient woodlands, peat bogs are rarely seen as biotopes in their own right, but rather as places to be used, and sometimes abused; in other words, the fairy-tale Cinders of our natural habitats.

The mood of antipathy and neglect which has prevailed towards peatlands for the past 500 years cannot be altered in just a few months or years. Nevertheless the recent past has witnessed a number of missed opportunities. The acclaimed BBC television trilogy of *Life on Earth*, *The Living Planet* and *The Trials of Life*, produced by the British Association's 1992 President, Sir David Attenborough, was a celebration of all the major life-forms and habitats on Earth. Peatlands cover more than 500 million hectares of the Earth's land surface and a significant proportion of this lies in northern temperate Europe. They possess some truly spectacular features, such as the vast string bogs of northern Scandinavia, the sprawling dubh-lock systems of the Flow Country in Scotland, and such extremes of adaptation as the carnivorous sundews or the remarkable bog-moss. Yet peatlands received scant attention in all these hours of television. It was as if they did not exist.

Only two 'popular' books have been published about the habitat in recent years – one by David Bellamy about Irish bogs (Bellamy, 1986) and one by the late Sir Harry Godwin (Godwin, 1981). Compare this with the huge number published about, say, woodlands. Even scientific books are remarkably sparse, with only four or five to choose

from (Moore and Bellamy, 1974; Gore, 1983; Moore, 1984; Williams, 1990; Rodwell, 1991).

Indeed the problem is not restricted to Britain. *Time/Life* have produced a vast array of stunning books about the Earth's ecosystems, but they have yet to produce one about peatlands. More remarkable still, the natural history of the two countries which possess some 90% of the Earth's peat resources, Canada and Russia, have been described in two sumptuous books (Fitzharris and Livingstone, 1988; Knystautas, 1987), yet neither contains a chapter about peatlands.

The National Peatland Resource Inventory

The National Peatland Resource Inventory (NPRI) was established by the former Nature Conservancy Council (NCC) and is now run by Scottish Natural Heritage (SNH) on behalf of all the official nature conservation agencies. Its original purpose was to provide a baseline account of the extent and variety of Britain's peatlands, from which a rolling programme of environmental audit would subsequently be possible. However, like so many national peatland inventories being carried out around the world, it has also turned into a catalogue of catastrophe.

Only the NPRI data for lowland raised bogs are presented here because of the particular focus of the debate currently raging between conservationists and the peat industry about the lowland resource. It is, however, worth observing that controversies such as forestry in the Flow Country illustrate the scale of problems faced by the far more extensive blanket bogs of Britain.

To provide an inventory it is first necessary to be clear about the definitions employed by the inventory. Bog peat, that is, peat raised above the mineral groundwater table and so fed only by direct rainfall, covers some 1.5 million hectares of Britain. Two major types of bog peat can be identified within this broad category: raised bog and blanket bog (Tansley, 1939; Goode and Ratchiffe, 1977; Wheeler, 1993). A third type, which represents the transition from raised bog to blanket bog, also occurs in Britain (Moore and Bellamy, 1974; Hulme, 1980; Lindsay and Andrews, 1993).

Raised bogs occur as individual domes of peat, occasionally occurring as a complex of domes, which rise above a surrounding non-peat landscape, and form an extremely acidic and stagnant environment totally dependent upon direct rainfall inputs for both water and minerals. They occur as large mounds of dead plant material, mainly bog moss, and a very great quantity of water. Indeed, walking on a raised bog involves walking on ground containing less solids than a heavily silt-laden river. It obeys largely the same laws of hydrophysics as a droplet of water on a flat surface, or the curved water table between mole drains (Ingram, 1992).

Blanket bogs, on the other hand, are peat systems which cloak the majority of the landscape with a more or less continuous blanket of peat, and in which non-peat areas represent islands surrounded by peat soils. The climate and nutrient regime necessary to produce these conditions are markedly different from those typical of raised bogs. The quantities of rainfall are very much greater, the influence of both salt spray and flushing on areas of markedly sloping blanket peat produce a nutrient budget which is very much richer than that typical of raised bog, and as a result the peat is generally much more decomposed and therefore thinner than typical raised bog deposits (Lindsay *et al.*, 1988).

This climate and nutrient regime predominates in the north and west of Britain, with

the result that only a few true raised bogs occur north west of a line running from Oban to Inverness (Lindsay & Andrews, 1993). Apart from the highly oceanic region of north and west of Scotland, peat formation in the lowlands is generally dominated by raised bogs. Blanket bog in the south is restricted to upland areas, dominating the high plateaux of, for example, the Pennines, the Scottish Southern Uplands, Dartmoor, and the uplands of mid-Wales.

The distribution of all peat bog types between England, Scotland and Wales, based on data digitized with the kind permission of the British Geological Survey from the 1:50 000 and 1"-scale Drift Edition maps, can be seen in Figs 1 and 2. These display the original area of bog prior to human activity. Figure 2 reveals that the vast majority of bog peat occurs as blanket bog in Scotland, with something over 1 million hectares. Blanket bog is also the dominant bog type in England and Wales. Raised bog peat, however, is most abundant in England with almost 38 000 h, whereas Scotland has only 25 000 h and Wales some 4000 h. The distribution of the raised bog resource can be seen in Fig. 3, but so small is it in national terms that the map is not particularly informative. Small and moderately sized sites all look fairly similar. Figure 4 therefore displays the same distribution, but on the basis of sized circles.

From this it is possible to see that England is dominated by a number of very large sites, whereas Scotland has a very considerable number of small sites. Wales has a mixture of sizes, but few sites in total. The main concentrations of sites occurs in the north west of England, mid- and west Wales, around the Solway, through the central Scottish lowland belt, and around the Grampian coastal plain.

Raised bog 'condition'

These data refer only to the original areas of raised bog, and take no account of the present condition of these peat deposits. It is possible to take each site (there are almost 1000 raised bogs listed in the NPRI) and describe it in terms of its current pattern of land-use conditions.

The first state is completely natural bog, with its living surface of bog moss, intact surface pattern and entire water table. Next is bog which is now no longer laying down peat, either because of burning or some hydrological disturbance and is therefore moribund. Then a bog may be drained, or may have been planted with trees. All these examples are surface phenomena, disrupting the surface hydrology, but not fundamentally changing the domed shape of the bog water table. In all such cases, primary bog therefore survives, and with sympathetic management the surface can be encouraged to become active again, after a fashion.

Next comes domestic peat extraction, or old abandoned commercial workings from the time of moss-litter for stables. These have old collapsed drainage systems which often encourage renewed *Sphagnum* bog moss growth, but this growth is of a secondary nature. The original peat, with its unique historical archive, has been lost and can only be replaced by completely new growth with an archive of modern times. The dome of the bog has been altered, which has significant implications for the hydrological stability of the bog in the future.

Modern commercial working consists of two types, the older block cutting and the more modern, widespread surface milling. This involves both steady removal of the peat body and, in the case of milled peat, the complete removal of the existing vegetation.



Figure 1. The distribution of all peat soils of more than 1 m deep for Britain, as indicated on the British Geological Survey (BGS) 1" or 1:50 000 scale Drift Edition map series. The individual maps were digitized, with the kind permission of the BGS, into pc-ARC/INFO and then plotted as a single map for Great Britain. The map indicates peat soils only, and gives no indication of peatland type, i.e. bog or fen, nor of the current condition of the surface. Thus the East Anglian Fens are indicated but most of this area is now under arable farming.

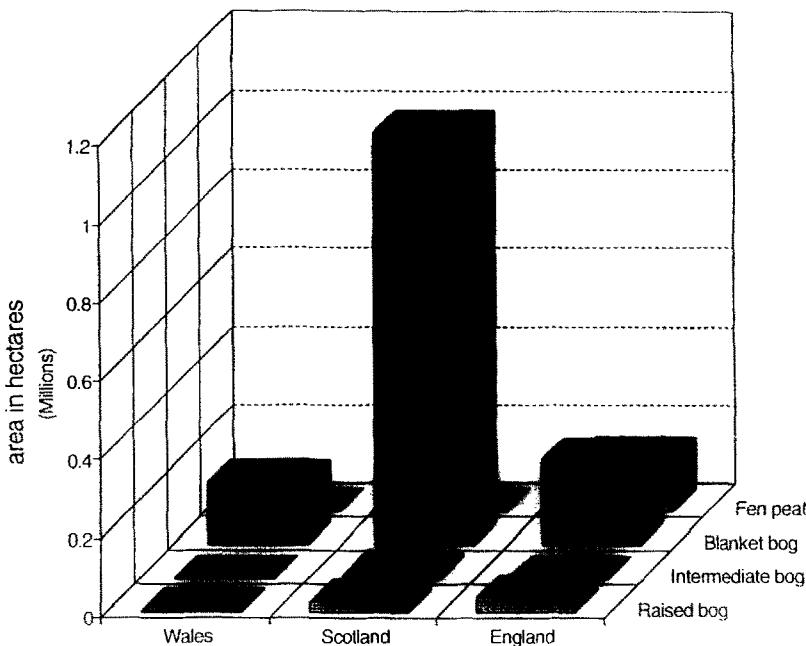


Figure 2. The distribution of the four major peatland types in Britain – fen peat, raised bog peat, blanket bog, and the sub-set of blanket bog known as intermediate or ridge-raised bog. The data have been taken from the NPRI digital dataset displayed in Fig. 1 and are displayed separately for the three countries. Fen peats in Wales and Scotland are poorly recorded on the British Geological Survey (BGS) from which these data were taken.

The peat still remains acidic and relies wholly on rainfall for all its needs and is therefore still a form of raised bog. Given positive management, the area can be encouraged to re-develop at least a secondary bog vegetation and return the area gradually back to more typically raised bog conditions.

Land which has been taken into agricultural usage tends to have had the peat stripped away down to the mineral groundwater table. The remaining peat is therefore no longer bog peat, but still possesses a partial peat archive and may play an important part in maintaining the water table of any adjoining remnant areas of bog.

Finally there is ground which has been excavated or built on, either for industrial or urban purposes. Open-cast coal mining may remove the peat entirely; peat is generally also removed prior to use of the site as a municipal rubbish tip. On occasion, urban sprawl may simply have swallowed up the site. Relatively few sites occur as just a single major land-use. It is more usual to find that a site has been, for example, partially cut-away by domestic peat cutting in the past, part has undergone land-claim for agriculture, and the remaining dome is somewhat drained and moribund. It is nevertheless generally possible to identify the major land-use class for any given site. In so doing, a pattern emerges as follows.

Urban/Industrial (Fig. 5)

Relatively few sites have been lost beneath either urban expansion or industrial development. The most marked are the large sites between Merseyside and Manchester,

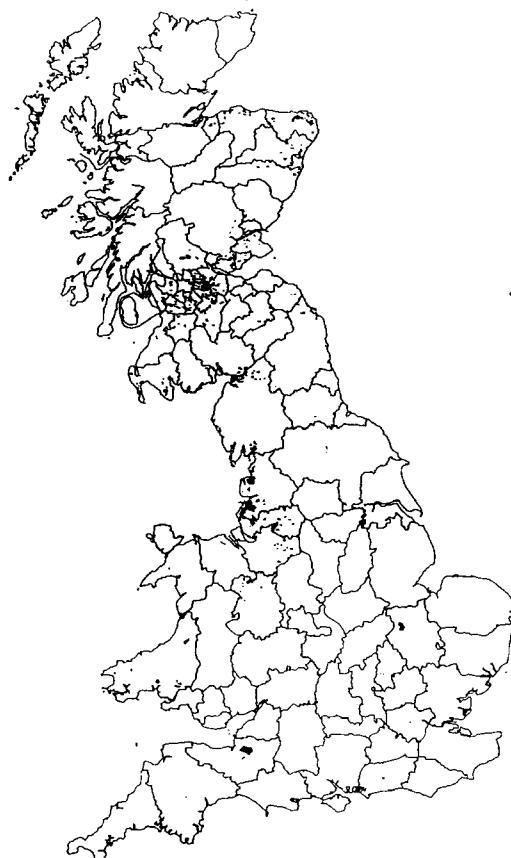


Figure 3. The distribution of all raised bog soils for Britain recorded within the NPRI. Sites were digitized from the British Geological Survey (BGS) 1" or 1:50 000 scale Drift Edition map series by kind permission of the BGS. County and Scottish District boundaries are also displayed. The map shows the original, rather than the present, distribution of raised bogs because it records only the presence or absence of a soil type, not the habitat.

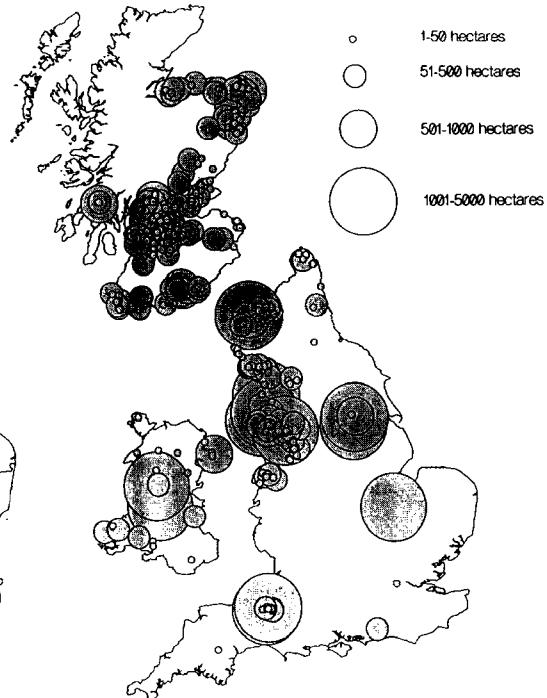


Figure 4. A schematic distribution map of the raised bog soils for Britain, based on the data used in Fig. 3. Individual sites are indicated by size-classes of circles whose area is proportional to the measured area of the total peat deposit for a site. Small circles are always positioned 'to the front' to avoid sites being obscured. The map illustrates the original extent of the habitat, rather than the present extent.

buried beneath urban refuse or colliery waste. More importantly, the collection of small sites in central Scotland represent sites lost to opencast coal mining. This is an expanding problem in the area, with several more sites currently under threat.

Agriculture (Fig. 6)

By far the largest of the land-use impacts, accounting for more than 30% of all land-use change, agricultural land-claim reached its peak of activity towards the turn of the last century. Since then it has steadily declined as a cause of habitat loss, but in its time it took many of the major raised bogs in England, notably the raised bogs in the East

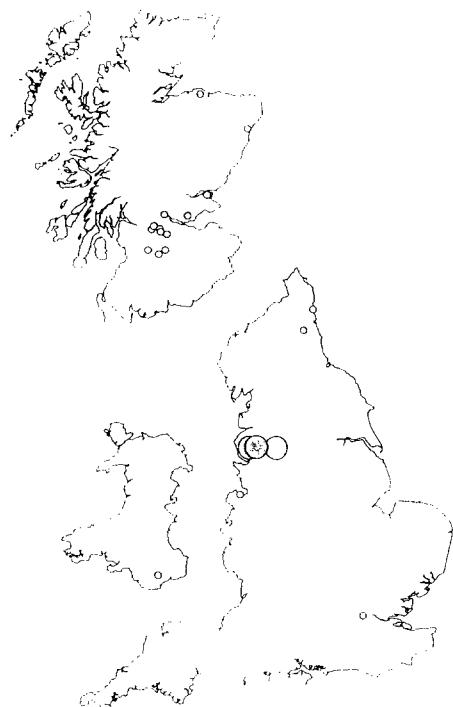


Figure 5. Hydrological units where the major land-use is now urban/industrial.

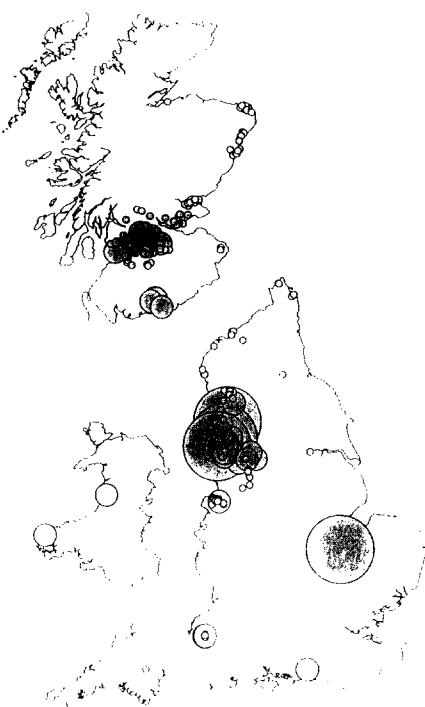


Figure 6. Hydrological units where the major land-use is now agriculture.

Anglian Fens and the bogs of the Lancashire coastal plains. It also accounted for a very large number of small sites in Scotland.

Commercial peat extraction (Fig. 7)

Many of the large raised bogs in England which were not caught up in the agricultural onslaught of the 1800s were instead acquired by the commercial peat industry, particularly during the post-war years. The Somerset Levels, Chat Moss near Manchester, and Thorne and Hatfield Moors in South Yorkshire, all have a long history of peat extraction, in some cases going back to the 1700s, but all are now subject to the very much more intensive commercial operations of the modern peat industry. The position in Scotland is also serious, but for rather different reasons. The majority of planning permissions in England date back to the early post-war years. Those in Scotland are largely less than ten years old.

Regenerating peat cuttings (Fig. 8)

Most of these are sites which were cut during the heyday of the moss-litter industry and were subsequently abandoned with the coming of the motor car and the decline of the horse as a means of transport. The majority of examples in Scotland are sites which have been cut traditionally for fuel, but such usage has also declined. Many of these abandoned sites have developed secondary bog vegetation of their own accord. Others, notably Fenns and Whixall Moss, on the Clwyd-Shropshire border, are being actively managed by conservation bodies to encourage such regeneration.

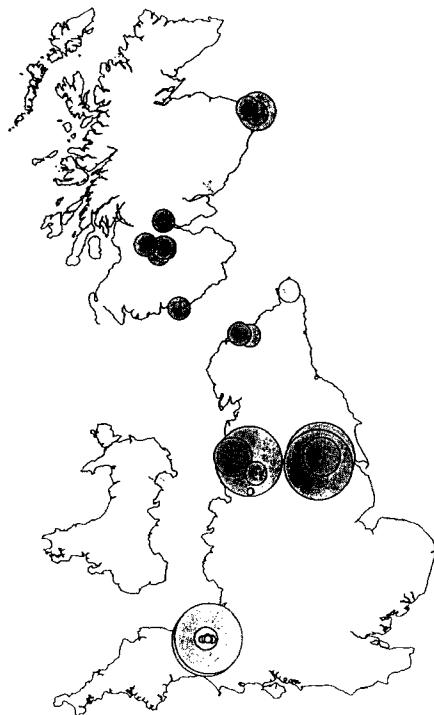


Figure 7. Hydrological units where the major land-use is now commercial peat extraction.

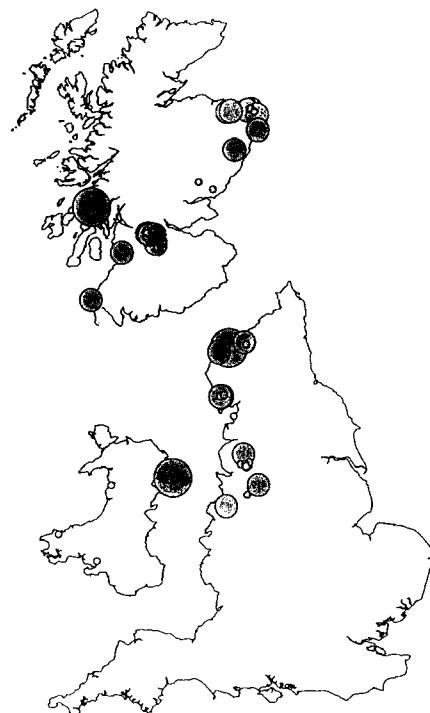


Figure 8. Hydrological units where the major land-use is now regenerating peat cuttings.

Woodland (Fig. 9)

This category includes both self-sown woodland which has invaded sites with lowered water tables, and also commercial forestry. Almost every example in England is self-sown woodland, except for Foulshaw Moss, Cumbria, which was planted as an experimental test-bed by the Forestry Commission. The reverse is true of Scotland; almost all losses to woodland are the result of afforestation schemes. Some sites, such as Gartrenich Moss, in the Forth Valley, were sites of specific scientific interest, but in the early 1970s were still planted. What is clear is that all three major centres of raised bog distribution in Scotland have suffered extensive planting.

Dense scrub (Fig. 10)

A few sites scattered throughout England and Wales have sites with lowered water tables and are at present being invaded by scrub, mainly birch. Usually these sites can retain a *Sphagnum* carpet beneath this scrub cover because the birch canopy is so light, and is virtually non-existent during the winter months after leaf-fall. Nevertheless, only a limited range of species persist, and development to mature woodland would be a serious problem.

Open primary bog – drained, burnt or natural (Fig. 11)

The distribution of completely natural, or slightly degraded bog where there may be drains, or the surface may have been burnt, reveals that the majority of Welsh sites are



Figure 9. Hydrological units where the major land-use is now woodland or afforestation.



Figure 10. Hydrological units where the major land-use is now dense scrub, usually with *Sphagnum* beneath.

still relatively natural. Scotland also has a substantial number of such sites, particularly in the central lowlands, but it is worth noting that the Solway shore has lost almost all its original sites. England, however, now relies almost entirely on small sites in Cumbria. The one large site remaining, at least as primary bog, is Bowness Common, Cumbria.

Natural primary bog (Fig. 12)

Looking instead at only those sites where natural primary bog is the *major* land-use, the picture changes dramatically. Wales has the two large sites Cors Caron and Cors Fochno, Scotland has a very much reduced number of moderately small sites only, but England has not a single example.

Measured natural bog (Fig. 13)

If the area of natural bog on all sites is specifically measured, the picture changes yet again. In England a few small examples re-appear, but the total area in both Wales and Scotland diminishes significantly. Less than 3500 h remain from an original area of 67 000 h, representing less than 5% of the total. A small area of unsurveyed raised bog still exists in Scotland, but even if all this proved to be natural primary bog, the total area would only increase to 5700 h.

Areas of measured natural vegetation often adjoin parts where substantial damage has taken place. For example, the largest area of natural primary bog vegetation in England



Figure 11. Hydrological units where the major land-use is active or degraded primary raised bog.



Figure 12. Hydrological units where the major land-use is active primary raised bog.

is Wedholme Flow, but the natural parts adjoin a substantial area of commercial peat extraction. The largest site overall, Flanders Moss, in Scotland, has some drainage, some afforestation, and part is currently subject to drainage for commercial peat extraction. A raised bog vegetation is totally dependent upon high water tables at all times, the drawdown from such adjacent areas represents a serious threat to the long-term survival of the natural parts unless positive conservation measures can be undertaken. Only where the entire site is free from anthropogenic disturbance is it possible to be confident that the area is stable and that active conservation management is not required. In the survey of almost 1000 raised bogs throughout Britain, not a single site was found to be in this state.

The historical context

Putting this pattern of land-use change into some sort of historical context, it is possible to obtain a picture from the results of surveys carried out by the Nature Conservancy Council which between them cover the major concentrations of raised bog in Britain. The first study examined raised bogs in both England and Scotland from the time of the first Ordnance Survey maps in 1840, through successive dates to 1978. It measured land-use change within the sites, and recorded the decline of open primary bog (see Fig. 14). The results show the huge losses caused by agricultural land-claim in the 1800s, the expansion of forestry after the First World War, and the steady loss of open bog. Taking



Figure 13. Measured area of active primary raised bog.

just the data for open bog, it is possible to see that, unless radical measures are taken soon, the graph will reach zero in no more than 25 years (see Fig. 15).

The second study examined the raised bogs of mid-Strathclyde, and provided detailed land-use maps for all areas of raised bog soil (McTeague and Watson, 1991). The area was chosen because it still contains some of the richest concentrations of surviving raised bog in Britain, and can, therefore, be taken as an example of the best survival pattern to be seen. This study also showed dramatic changes, however, with the remaining area of natural raised bog representing no more than 12% of the total.

Combining these data with the more general picture obtained from the National Peatland Resource Inventory (NPRI), the combined graph of all three studies shows that the natural habitat is heading inexorably for an extinction point somewhere shortly after the turn of the millennium (see Fig. 16).

Positive conservation for the future

If things continue as they have been, it is clear that Cinderella is doomed never to escape the kitchen, indeed is doomed completely. Even if the graphs level off now, today and no further land-use change is permitted, so little remains that just a few natural calamities such as a serious fire will take the remainder ever closer to the zero line. Furthermore, the majority of natural fragments are precisely that, fragments, which are hydrologically unstable and which will thus continue to change without active management intervention.

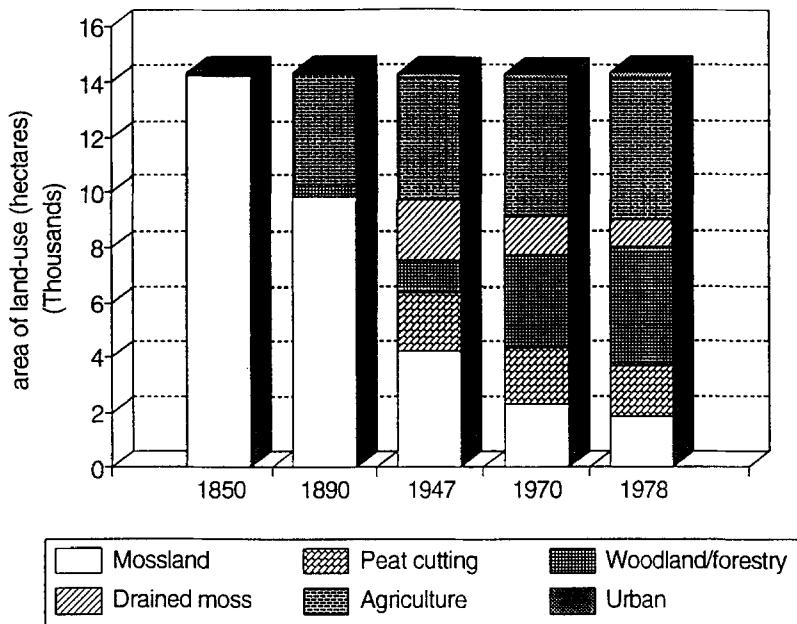


Figure 14. The change in land-use for areas of raised bog between 1840 and 1978 according to data collected by the Nature Conservancy Council (unpublished data) for four major areas of raised bog habitat in Britain. The study areas were the Lancashire coastal plain, south Cumbria, the Solway coastal plain, and the Forth Valley.

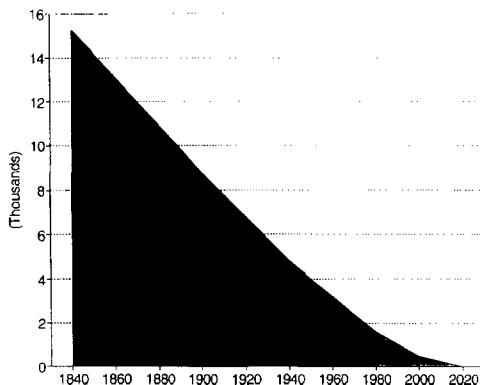


Figure 15. The decline in area of natural primary raised bog between 1840 and 1978 as indicated by the data collected by the Nature Conservancy Council (unpublished data) for four major areas of raised bog habitat in Britain. The paler area of the graph is a projection beyond the final date of the study (1978) to estimate when there might be total loss of the natural habitat.

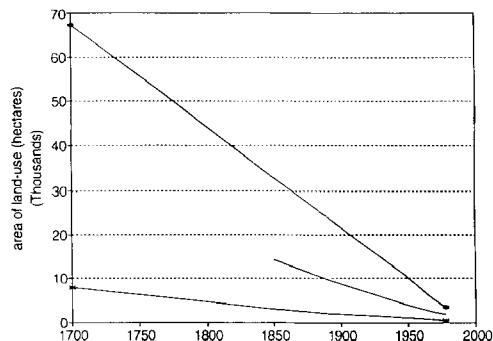


Figure 16. The three datasets available for Britain concerning loss of raised bog habitat have been combined in this graph to obtain an overall picture of the rate of land-use change. The data for all three graphs are more or less equivalent, being based on the remaining area of primary active bog. The three datasets are Lindsay *et al.* (1993), McTeague and Watson (1991) and the Nature Conservancy Council data from Figs 14 and 15.

There is, however, a substantial area which still retains some potential for the restoration of a form of raised bog environment. Much of this is either presently under forestry or subject to commercial peat extraction. The danger is that the longer these land-uses continue on the site the more difficult it is to be sure of retaining bog conditions for rehabilitation. A much smaller area is drained, burnt or scrub covered, but with active conservation-management, such sites can be encouraged to return to natural primary bog, given time, and given sufficient resources and support.

A fairy story of course should have either a moral, or a happy ending. This, potentially, has both. The moral is that one of the jewels of our natural heritage has almost been allowed to slip through our fingers through sheer neglect – as a result we have the environment we deserve. The happy ending depends on what we choose to do in the next few years, but one might say that the job of conservation is, through positive conservation management, to turn the downward plunge of the graph in Fig. 16 back upwards again.

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